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COMPARATIVE TOXICITY OF SOME INSECTICIDES AGAINST RICE LEAF FOLDER (*Cnaphalorosis medinalis*) UNDER FIELD SITUATIONS

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The present research trial was executed to probe the relative efficacy of some new insecticides formulation with old ones against *Cnaphalorosis medinalis*. Four synthetic insecticides were applied with three replicates at recommended dose rates. Toxicity trials were performed under RCBD. The results of the toxicity experiments disclosed the lowest mean leaf reduction damage (6.84%) after 14 days of 2nd spray by application of Flubendamide followed by Emmamectin Benzoate (15.03%). The damage was reduced 17.21-17.00% in case of Fibronil and 17.19-16.12% by Lambda cyhalothrin but was superior to untreated plots. The results of 1st spray revealed that the lowest mean leaf damage (12.24%) was noted in case of Flubendamide application among the tested insecticides. In case of yield analysis, the highest percent grain filling (92.34%) was examined in Belt insecticide trailed by Timer (87.12%), whereas the lowest (70.46%) was noted in case of control. Increase in yield (%) disclosed that the highest increase in yield (21.54%) was recorded in application of Belt insecticide, while relatively the lowest (10.23%) was observed in Boxer insecticide. Overall, the results depicted that the longest exposure period proved more effective as relative high reduction in leaf damage, and Flubendamide was the most effective among the all tested insecticides. Hence, this insecticide can be used in Intergrated Pest Management Program (IPM) for the successful management of *C. medinalis*.

Keywords: *Oryza sativa*, insect pests, IPM, pest scouting, toxicity bioassays, efficacy.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most significant staple food in Asia. Above 90% of the world's rice is cultivated and consumed in Asia, covering 60% of the total world's population (Geoff *et al*., 2012). Rice crop is being attacked by many insect pests. Among these insects, yellow stem borer (*Sciropophaga isertulas*), brown plant hopper (*Nilaparvata lugens*), white backed plant hopper (*Sogatella furciferra*) and leaf folder (*Cnaphalocrosis medinalis*) are the communal insect pests infesting the rice crop (Padmavath *et al*., 2009).

In Pakistan, *C. medinalis* has caused huge yield losses owing to its occurrence in 1989 (Rehman *et al*., 2003). Larvae of *C. medinalis* causes a noticeable damage to rice crop by twisting leaves and scraping off the green matter of leaves. Farmers typically react by using insecticides, even at very low attack of *C. medinalis* (Heong *et al*., 1994). Infestation levels are typically described merely as attacked leaves (%) and some researchers reported the influences affecting population dynamics of this insect pest (Bashir *et al*., 2004). Larva constructs a shielded nourishing compartment by twisting or folding together the leaf lamina and adhesives it with silk threads and nourish on green tissues (Punithavalli *et al*., 2013; Zhu *et al*., 2015). The attacked surface shows transparent and longitudinal white lines on leaf lamina. Hence, the infestation decreases green matter content from leaves which finally impacts on the crop yield (Park *et al*., 2014). The photosynthetic capability and overall strength of an attacked plant is severely affected (Nathan *et al*., 2004; Padmavathi *et al*., 2013). Some other crops like sugarcane, sorghum, wheat and corn are also attacked by *C. mednalis* (Khan *et al*., 1996), but rice is the highly desired host plant of this insect pest (Shah *et al*., 2001; Bodlah *et al*., 2016). Among diverse rice varieties, *C. medinalis* preference varies from fine-aromatic varieties to the short, average period and non-aromatic ones (Punithavalli *et al*., 2011; Supawan and Chongrattanameteekul, 2017). The high yielding vulnerable rice varieties are the highly preferred ones for existence and population buildup of this insect pest. *C. medinalis*

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experiences trouble to nourish, develop, live and reproduce adequately on resilient rice cultivars. The occurrence of twisted leaves has been noted greater on broad and long leaves rice varieties (Chalapathi *et al*., 2002). Environmentalists have observed the population fluctuations of insect pests as one of the significant aspect in evaluating the population of the desired insect pest (Soleimani and Madadi, 2015). Numerous studies have reported the occurrence and profusion of *C. medinalis* in altered seasons, crop developing times and varietal preference (Akhter *et al*., 2015). The insect pest profusion in crops is prominently affected by the local micro
climate (Rehman *et al*., 2005). Extended times of high/low humidity levels, rainfall and temperature can upsurge or abridge the insect pest populations (Iqbal *et al*., 2010; Bodlah *et al*., 2019).

The integrated pest management practices like use of resistant varieties (Rekha *et al*., 2001), light traps etc. have substantial effect on management of this insect pest; however, insecticides still remain the major control measure against leaf folder (Senthil *et al*., 2004; Haider *et al*., 2014). In another study, Kulagod *et al*. (2011) stated that Flubendamide gave better control and reduced leaf damage by rice leaf-folder. Sharma and Srivastava (2008) reported that Lambda cyhalothrin (Karate zeon 5CS) with 3.22% and 2.82% DL proved more efficacious than the monocrotophos (4.26% and 3.81% DL) for the control of leaf-folder, *C. medinalis*. Now-a-days, growers are using diverse nature insecticides for controlling rice *C. medinalis* in their crops; few of these are blending together two chemicals too. Nevertheless, typically they are applying customary insecticides like Lambda cyhalothrin consistently which results in unexpected knock down impact. However, the outcomes are not described as extensive as they must be. Fepronil is among the communal granular insecticides used for the control of lepidopteron insects. Keeping in view the above scenario, present research trial was planned to assess relative efficacies of four insecticides to probe the best one for the control of *C. medinalis*.

MATERIALS AND METHODS

The research trial was executed at research area of plant protection department Faisalabad during Kharif 2019-20. The trial was performed under RCBD design with 3 replicates and 4 diverse insecticides were used to investigate the relative toxic effects against the *C. medinalis*.

Table 1. Descriptions of insecticides applied in the research trial.

Insecticides	Formulation	Active Ingredient	Dose/Acre
Timer	1.9 EC	Emmamectin Benzoate	200 ml
Notice	5 SC	Fibronil	480 ml
Belt	480 SC	Flubendamide	25 ml
Boxer	2.5 EC	Lambda cyhalothrin	250 ml
Control	-	-	-

Nursery of rice was raised on 10th June 2019 and transplanted on 19th July 2019. Pest scouting was initiated by counting the moths of the insect seemed in the crop and the damage per plant (%) was calculated by formula given below;

$$\text{Plant infestation (\%)} = \frac{\text{Number of infested plants/plot}}{\text{Total number of plants/plot}} \times 100$$

The observations were made prior to spraying the insecticides and 1,3,5,7 and 14 days after treatments (DAT). Once more, spraying was done after fifteen days and results were noted in similar way for assessment the effectiveness of insecticides against *C. medinalis* and crop yield parameters were also noted down to probe the highly effective insecticide.

Table 2. Mean leaf damage (%) by *C. medinalis* after 1st spray.

Treatments	BS	1-DAT	3-DAT	5-DAT	7-DAT	14-DAT
Timer	17.61	17.45	17.31	17.06	17.02	17.00
Notice	18.19	18.01	17.96	17.82	17.39	17.10
Belt	15.06	14.98	14.50	14.25	14.08	12.24
Boxer	16.56	16.42	16.23	16.20	16.17	16.35
Control	14.45	14.92	15.50	16.10	18.89	19.45

DAT=days after treatment, BS=before damage

Table 3. Mean leaf damage (%) by *C. medinalis* after 2nd spray.

Treatments	BS	1-DAT	3-DAT	5-DAT	7-DAT	14-DAT
Timer	16.90	16.64	16.21	16.08	15.51	15.03
Notice	17.21	17.16	17.11	17.08	17.03	17.00
Belt	15.76	14.10	13.76	12.02	10.01	6.84
Boxer	17.19	17.01	16.56	16.31	16.26	16.12
Control	13.54	15.09	15.73	18.14	18.53	20.03

DAT=days after treatment, BS=before damage

RESULTS

Data presented in Table 2 displays variation in mean leaf damage resulted by infestation of *C. medinalis*. The mean damage reduced after the insecticides spray. However, noticeable low mean leaf damage (12.24%) was noted in case of Flubendamide application among the tested insecticides. The other insecticides no doubt were also effective compared to the control. The longest exposure period resulted in higher reduction in leaf damage.

Table 3 shows changes in mean leaf damage caused by *C. medinalis* infestation over the different periods of post insecticidal application. The lowest mean leaf damage (6.84%) was noted after 14 days of 2nd spray by Flubendamide, whereas Emmamectin Benzoate was the next effective one (15.03%). The damage was reduced 17.21-17.00% in case of Fibronil and 17.19-16.12% by Lambda cyhalothrin but higher than untreated plot.

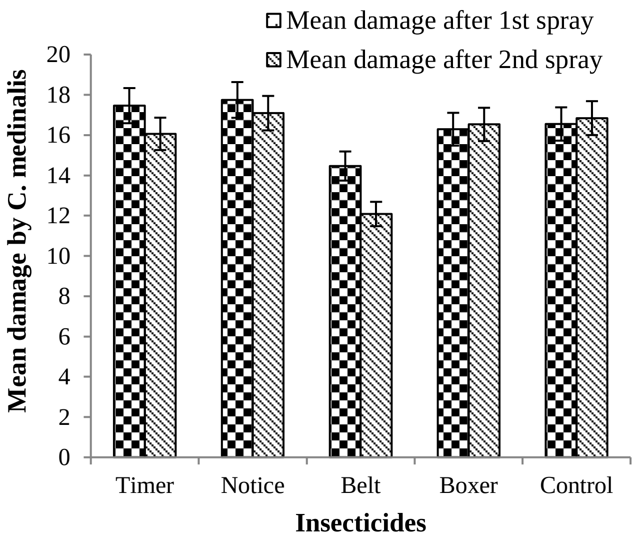

Figure 1. **Mean damage caused by *C. medinalis* after 1st and 2nd spray of different insecticides.**

Figure 2 displays variation in mean damage of leaf resulted by attack of *C. medinalis.* The longest exposure proved more effective as relatively greater reduction in leaf damage (15.29%) was noted after 14 days, while exposure period of 1 day was the least effective. Other exposure periods gave intermediate results**.**

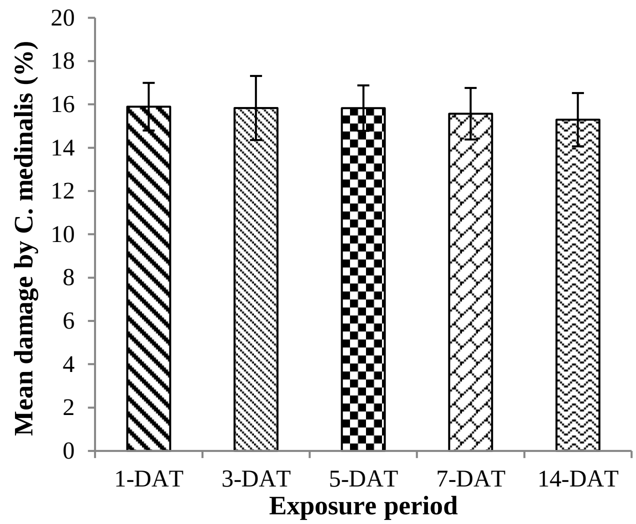

Figure 2. **Mean percent damage caused by *C. medinalis* after different exposure periods of the insecticide sprays.**

Results (Table 4) depicted that The highest percent grain filling (92.34%) was noted in Belt application followed by Timer (87.12%), Notice (81.56%) and Boxer (77.29%) whereas the lowest (70.46%) was recorded in case of untreated experimental units. Similarly, the highest increase in yield (21.54%) was noted in case of Belt application while relatively the lowest (10.23%) was noticed in case of Boxer insecticide.

Table 4. **Mean of grain filling, yield per acre and percent increase in yield over control**

Treatments	Grain filling (%)	Yield/acre	Increase in yield (%)
Timer	87.12	2692.19	18.31
Notice	81.56	2410.51	12.78
Belt	92.34	2742.65	21.54
Boxer	77.29	2276.06	10.23
Control	70.46	2015.04	-

DISCUSSION

Present research was conducted to evaluate the relative effectiveness of four insecticides against *C. medinalis*. The results showed that among all the tested insecticides, Flubendamide was the most effective followed by Emmamectin Benzoate while Lambda cyhalothrin was the least effective. Our results are supported by Jamshed *et al*. (2000) who noticed that all the tested entomocidal chemicals expressively abridged the *C. medinalis* infestation over control. The entomocidal chemicals also meaningfully abridged the mean folding (%) of rice crop leaves by *C. medinalis*. Padmavathi *et al*. (2013) also observed that *C. medinalis* larva twists the leaves and scrapes the green

matter from inside the fold causing desiccation and scorching of the leaves. The results of our study are close to Soomro *et al*. (2020) who assessed the relative efficacy of different insecticides against *C. medinalis* and found Flubendamide the most effective as was noted in our results of study. Our results are in line with Kraker *et al*. (1999) who examined leaf damage by *C. medinalis* larvae which became noticeable after 28 days of rice nursery transplanting. The number of attacked leaves per hill was abundant at flowering stage, and reduced towards fully grown stage owing to leaf aging. Findings of the research trial revealed that the pest presence was observed at booting stage of rice crop, preferred to attack the flag leaves, abridged grain filling and eventually yield reductions were perceived. The highest yield increase was noted in Belt 480SC (21.54%) followed by Timer (81.31). our results are in line with Padmavathi *et al*. (2013) that flag leaf area damage exceeding 25%, caused greater >50% unfilled grains than control at flowering stage, displaying direct impact of yield decrease in rice.

Conclusion**:** It can be concluded that *C. medinalis* is serious insect pest of rice crop in Pakistan and worldwide. Insecticides especially Flubendamide and Emmamectin Benzoate can be effective IPM for the efficient control of this insect pest for augmentation of crop yield.

Author contribution statement**:** Rehman H and Ahmed M: Conducted the experiment; Rehman H, Ahmed M and Yasir M: Wrote the manuscript; Shahbaz M: Co-supervised research study and performed data analysis; Ahmed F**:** Assisted in field data collection and layout of experiment; Rehman H**:** Contributed in the framing and executing the research idea, assisted in design layout and proofreading; Ahmed M**:** Assisted in data collection and laboratory work; Rehman H and Yasir M**:** Reviewing and editing

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Conflicts of Interest**:** The authors declare no conflict of interest.

REFERENCES

Bashir, K., H. Tayyab, F. Tahira, L. Zakia, S.A. Mehdi and R. Sheikh. 2004. Field evaluation and risk assessment of transgenic *indica* basmati rice. Mol. Breed. 13:301-312.

Bodlah, M.A., L.L. Gu, G.R. Wang and X.D. Liu. 2019. Rice leaf folder larvae alter their shelter-building behavior and shelter structure in response to heat stress. J. Econ. Entomol. 112:149-155.

Chalapathi, R.N.B.V., V.S. Singh and C. Subhash. 2002. Evaluation of rice germplasm for resistance to rice leaf folder, *Cnaphalocrocis medinalis*. Ind. J. Entomol. 64:124-129.

Geoff, M., M.Y.G. Donna, R. Josie, A.L. Catindig, J. Cheng, J. Liu, L. Pham and L. Kong. 2012. Parasitoids of the rice leaffolder, *Cnaphalocrocis medinalis* and prospects for enhancing biological control with nectar plants. Agric. Forest Entomol. 14:11-12.

Heong, K.L., M.M. Escalada and V. Mai. 1994. An analysis of insecticide use in rice: case studies in the Philippines and Vietnam. Int. J. Pest Manag. 40:173-178.

Jamshed, I., L. Khan, M.K. Khattak, A.S. Hussain and K. Abdullah. 2000. Comparative efficacy of some insecticides against rice stem borers (*Tryporyza incertulus* wik. and *T. innotatawik*) and leaf folder (*Cnaphalocrocis medinalis*) in D.I. Khan, Pakistan. Pak. J. Biol. Sci. 3:110-113.

Kraker, J., A. Van, K.L. Huis, J.C. Heong, V. Lenteren and R. Rabbinge. 1999. Population dynamics of rice leaffolders (Lepidoptera: Pyralidae) and their natural enemies in irrigated rice in the Philippines. Bull. Entomol. Res. 89:411-421.

Kulagod, S.D., M. Hegde, G.V. Nayak and A.S. Vastrad. 2011. Influence of fertilizer on the incidence of insect pests in paddy. J. Agric. Sci. 24:244-246.

Nathan, S.S., P.G. Chung and K. Murugan, 2004. Effect of botanical insecticides and bacterial toxins on the gut enzyme of the rice leaf folder *Cnaphalocrocis medinalis*. Phytoparasitica 32: 433-443.

Padmavath, C., I.G. Katti, A.P. Padmakumari, S.R. Voleti and L.V.S. Rao. 2013. The effect of leaffolder *Cnaphalocrocis medinalis* (Guenee) [Lepidoptera: Pyralidae] injury on the plant physiology and yield loss in rice. J. Appl. Entomol. 137:249-256.

Park, H.H., J.J. Ahn and C.G. Park, 2014. Temperature dependent development of *Cnaphalocrocis medinalis* Guenee (Lepidoptera: Pyralidae) and their validation in semi-field condition. J. Asia Pac. Entomol. 17:83-91.

Punithavalli, M., N.M. Muthukrishnan and R.M. Balaji. 2011. Influence of rice leaf morphology on the folding characteristics of rice leaffolder, *Cnaphalocrocis medinalis*. Ind. J. Plant Prot. 39:93-99.

Punithavalli, M., N.M. Muthukrishnan and M.B. Rajkumar. 2013. Influence of rice genotypes on folding and spinning behaviour of leaffolder (*Cnaphalocrocis medinalis*) and its interaction with leaf damage. Rice Sci. 20:442-450.

Rekha, R.L., R. Singh and R. Singh. 2001. Sources and mechanisms of resistance in rice against rice leaffolder,

Cnaphalocrocis medinaus (Guenee): A review. Agric Rev. 22:1-12.

Rehman, A., M. Saleem, M. Ramzan and M. Akram. 2005. Some bioecological studies on leaffolder: A major pest of rice in Pakistan. Proc. Int. Seminar on Rice, Kala Shah Kaku, Pakistan; pp.262-274.

Senthil, N.S, P.G. Chung and K. Murugan. 2004. Effect of botanical insecticides and bacterial toxins on the gut enzyme of the rice leaffolder *Cnaphalocrocis medinalis*. Phytoparasitica 32:433-443.

Shah, S.M.A., H. Rahman, A. Rehman, F.M. Abassi, H.I. Khalil and A. Ali. 2001. Characterization of wild rice species in response to leaffolder *Cnaphalocrocis medinalis*. Sarhad J. Agric. 24:69-74.

Sharma, P.K. and A. Srivastava. 2008. Efficacy of insecticides in rice in mid-hills of Himachal Pradesh. Agric. Sci. Digest 28:277-79.

Soomro, A.S., S.N. Mazari, M.H. Hulio, J.A. Soomro and G.Q. Junejo. 2020. Efficacy of different insecticides against rice leaf folder (*Cnaphalorosis medinalis*) under field conditions. Int. J. Appl. Sci. Biotechnol. 8:211-215.

Supawan, J. and W. Chongrattanameteekul. 2017. Influence of humidity, rainfall, and fipronil toxicity on rice leaffolder (*Cnaphalocrocis medinalis*). Sci. Asia 43:82-87.

Zhu, A.X., Q. Qian and X.D. Liu. 2015. A method for rearing the rice leaf folder (*Cnaphalocrocis medinalis*) using wheat seedlings. Chinese J. Appl. Entomol. 52:883-889.